REFINEMENT PROCESS TO PRODUCE PRELIMINARY PHASE II ALTERNATIVES

The CALFED Bay-Delta Program is in the process of developing and refining alternative solutions to problems of the Bay-Delta system. Currently, the Program has narrowed the range of solutions to ten refined alternatives which have recently been the focus of attention in a formal Scoping process. At the same time, staff of the Bay-Delta Program have been working with CALFED agencies to evaluate the ten alternatives against solution principles. Both of these processes have suggested a modification in the structure of alternatives. Currently the alternatives vary in the level of effort applied to actions related to ecosystem quality, water quality, system vulnerability, and water use efficiency. It appears that it may be more appropriate to include each of these as a common program that is essentially the same across a range of alternatives. This range of alternatives would thus be defined by variations in components related to Delta conveyance and water storage.

The scoping comments, evaluations, and reasoning that have led to this proposed change in the structure of alternatives are summarized below.

Current Status and Structure of Ten Alternatives

All of the draft alternatives developed by the Program, including the initial set of 20 and the refined set of ten, were structured to include a varying level of effort applied to certain components of the alternatives. Levels of effort characterized as *modest*, *moderate*, or *extensive* were applied to many of the components. This approach was used originally in order to provide a range of solution alternatives, and to offer a very rough level of equity meeting different objectives within each alternative.

At the beginning of the process a different approach was proposed, in which most components of the alternatives remained constant, and the alternatives varied only with respect to the water supply components, in particular Delta conveyance. At the time, this approach was dismissed because it appeared to concentrate solution-finding effort on problems related to water supply while devoting relatively little planning effort to solution of other problems in the Bay-Delta.

The information package for Workshop 6 categorized actions into 20 components within the four resource areas of water supply, water quality, ecosystem quality, and system vulnerability. We can simplify the structure by forming larger components. Using this approach, the current set of ten alternatives can be described as including components related to **ecosystem quality, water quality, system vulnerability, water use efficiency, Delta conveyance, and water storage**. Each alternative also includes the same set of core actions.

The first four components vary principally in the level of effort applied. The two components that include distinctly different approaches among the alternatives are Delta conveyance and water storage.

Issues from Scoping

During April and early May the Program conducted nine scoping meetings around the state, a workshop in Sacramento, and a meeting of the Bay-Delta Advisory Council. The scoping period has been formally extended to May 20. A scoping report is being prepared based on comments received to date, and will be updated after the scoping period concludes.

The comments cover a wide range of technical, policy, and financial concerns (see separate document entitled *Key Emerging Issues Summary*). Some of the comments have prompted consideration of modifying the structure and presentation of the alternatives. These comments have led us to conclude that several components in the alternatives might be more appropriately treated as programs that must be included in all the alternatives. Some of these comments and our conclusions are:

Water use efficiency must be strongly pursued in all the alternatives. This suggests that water use efficiency measures should be implemented at a vigorous level among all the alternatives, where previously they included efficiency at modest or moderate levels. Alternative A, Extensive Demand Management, is the one current draft alternative that relies principally on water use efficiency to balance supply and demand. While there was great concern expressed that Alternative A may have gone too far and utilized some improper approaches, it was generally agreed that a high level of water use efficiency is essential. If the Program adopts the approach that water use efficiency is implemented at the same level in each alternative, this common water use efficiency component will need to be developed with consideration of differences in local conditions and local needs.

The best possible source water quality is of paramount importance to urban water suppliers. Agencies that deliver drinking water are very concerned about the cost of meeting future drinking water quality standards, as well as the technical challenges associated with treating source water of degraded quality. This suggests strong pollutant source control measures in every alternative.

Delta levees will be needed to protect agriculture, infrastructure, and habitat no matter how water is conveyed in the Delta. Among the values protected by Delta levees, only water quality varies among alternatives (according to the method of conveyance). Adequate levee integrity is required to protect other values regardless of the method of Delta water conveyance. This argues for a similar level of protection in each alternative.

Ecosystem actions at the modest and perhaps the moderate level appear inadequate; the Program needs a single coherent vision of ecosystem restoration. We have already acknowledged that adaptive management will be vital in guiding our efforts to improve

ecosystem quality. It is this adaptive management that will provide the needed flexibility in ecosystem quality improvement. There is really no alternative to a single comprehensive plan for restoring ecosystem health.

In response to comments such as these, some components of the alternatives can be viewed in a different way. Water use efficiency, water quality, system vulnerability, and ecosystem quality could be viewed as *programs* that are present in all the alternatives, and are composed of a series of actions that are implemented incrementally over time.

Alternative Refinement and Evaluation Against Solution Principles

The next activities for the Program will include additional refinement of alternatives, leading to selection of Phase II alternatives that is large enough to offer a reasonable range of solutions while small enough to allow for detailed analysis.

Additional refinement of the ten alternatives is proceeding according to these steps:

1. Review how each alternative satisfies the Mission Statement and Objectives.

2. Review input from CALFED, BDAC, scoping meetings, workshops, stakeholders, and the public on each alternative.

3. Evaluate and document how well each alternative satisfies each Solution Principle.

4. Determine potential ways to modify each alternative to improve any low Solution Principle ratings.

5. Verify that the alternative, if revised, would still meet the Objectives and the other Solution Principles.

6. Review the alternatives and potential modifications to identify improved alternatives.

7. Merge similar improved alternatives into a single alternative.

Staff from CALFED agencies and the Program team are evaluating alternatives against Solution Principles. As the detailed Solution Principles are applied to the ten alternatives, and modifications are being devised to improve low Solution Principle ratings, a pattern is emerging. Several components are becoming more similar across the range of alternatives. Some of the potential improvements that could be made in several of the alternatives are these:

- Reduce the magnitude of land retirement to reduce indirect impacts (eliminate redirected impacts) and provide more equity; develop alternative approaches to achieve agricultural conservation;

- Add more habitat, on the order of Alternative F with upper Sacramento River meander belts, to provide higher conflict resolution and durability; (as the magnitude of ecosystem restoration increases, it will be necessary to rely more heavily on adaptive management to guide actions beyond the initial stages of the restoration program);

- Add additional fish screening to reduce conflict and provide higher durability;

- Increase water quality actions to provide higher conflict resolution;

- Increase levee maintenance to provide higher conflict resolution and provide more durability;

- Add subsidence control program to provide higher conflict resolution, higher durability, higher implementability and eliminate redirected impacts;

- Increase emergency response to provide higher conflict resolution, higher durability, higher equity, more implementability, and to eliminate redirected impacts.

Application of Solution Principles and modification of alternatives to better meet the principles tends to make the draft alternatives more similar to one another in some ways. This is particularly true for components of the alternatives related to water use efficiency, water quality, system vulnerability, and ecosystem quality. Some changes made to the components in order to better meet Solution Principles may reduce the level of effort. However, many changes tend to increase the level of effort in components previously described as modest.

For example, Alternative A offered a water use efficiency component that satisfied most of the solution principles moderately well. However, the extensive land retirement described in Alternative A made it weak in meeting the Solution Principles of *equity* and *no significant redirected impacts*. Reducing the level of land retirement makes the water use efficiency component satisfy the Solution Principles better. When improvements are made to the water use efficiency components of other alternatives to better satisfy Solution Principles, the basic approach to demand management (water use efficiency) tends to converge to a single program.

Implications for Program Direction and Alternative Structure

As a result of comments received to date in scoping, and our evaluation of alternatives against Solution Principles, we may view each of the preliminary Phase II alternatives as composed of two parts. The first part of each alternative might consist of variable components related to water storage and Delta conveyance. This part of the alternative would also address increased opportunities for water transfers that result from storage and conveyance. The second part of

each alternative might contain certain uniform components or common programs related to water use efficiency, water quality, system vulnerability, and ecosystem quality. The core actions identified earlier in the program would also be part of these uniform components. Components in this second part of the alternative are really programs that would consist of actions or projects which are initiated in stage I of the alternative with continued implementation over time. As a result, the preliminary Phase II alternatives may not be a list of discrete alternatives, but rather a matrix of the variable components combined with a set of relatively uniform common programs.

The array of alternatives evaluated during Phase II might be portrayed using the matrix format shown below:

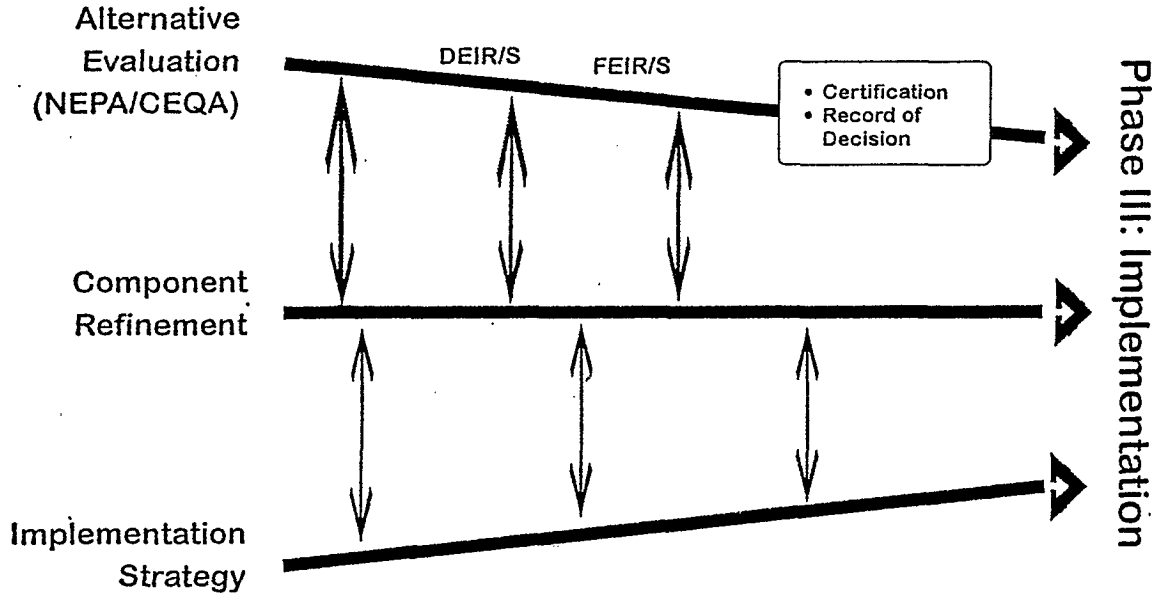
POTENTIAL PHASE II ALTERNATIVES MATRIX				
Conveyance Component:	Existing	Through Delta Modification	Dual System	Isolation
Storage Component:				
Common Programs:	Core Actions			
	Water Use Efficiency Program			
	Ecosystem Restoration Program			
	Levee Integrity Program			
	Water Quality Program			

Although the common programs would be very similar in each alternative, there would be significant differences in the details of the common programs in order to complement the variable components of the particular alternative. For instance, the ecosystem restoration component of each alternative might include restoration of shallow water habitat in the Delta. If an alternative continued to rely on exports from the existing south Delta pumping plants, then shallow water habitat might not be located in the south Delta where fish would be vulnerable to entrainment. Among the common programs, the water use efficiency common program will need to be particularly flexible because it will be closely tied to the variable conveyance and storage components and the opportunities for water transfers. Still, the goal of the water use efficiency common program would remain the same across all the alternatives.

Many actions, including ranges of implementation level, have been described in the ten alternatives. These actions provide the basic framework of the components, but should not be considered final or definitive. Refinement of all the components, including the common

programs, will continue well into Phase II of the Program. This refinement will include determination of both the level of effort and the specific combination of actions included in each component, as well as preliminary site evaluation.

Phase II component refinement will take place concurrently with the alternative evaluation that leads to preparation of an environmental impact report and environmental impact statement, and there will be extensive feedback between these two processes. A third concurrent activity will be the continuing development of an implementation strategy. This strategy will address technical, financial, institutional, and organizational decisions necessary to provide for the beginning of implementation during Phase III of the Program. The three concurrent efforts in the Phase II process can be depicted as shown below.



An approach that uses common programs combined with variable components offers several advantages. The common programs offer consistent solutions to problems in several resource areas where this seems appropriate. At the same time, these common programs will greatly reduce the complexity involved in modeling the alternatives and comparing alternatives on the short list. Common programs that are implemented incrementally over time offer the flexibility to apply adaptive management and the opportunity to make actions more affordable by financing costs over a period of time.

Each of the common programs and variable components is described below.

COMMON ALTERNATIVE COMPONENTS

Core Actions

Description

A core action is an action at a specific implementation level that would be included as an element of all CALFED Program alternatives and would be beneficial to the Delta regardless of the selected Program alternative. The core actions are those that need to occur for Bay-Delta improvement even without implementation of a specific CALFED comprehensive solution.

Core actions include an array of actions for Bay-Delta habitat restoration, upstream habitat restoration, watershed management, reductions in the effects of diversions and barriers on fish, management of anadromous fish, improved water use efficiency, water supply enhancement, increasing water supply reliability/predictability, and improvements to system integrity. Including such actions in all alternatives would be based on consensus among all stakeholders that implementation of the actions are important and acceptable to contribute to meeting one or more Program objectives in a cost-effective way.

A prime benefit of the core actions is that they could potentially be candidates for early implementation before completion of studies, design, and implementation of the remaining actions that will make up the Program many years from now.

A concern with core actions is that they require a significant dollar commitment and may provide only marginal benefits if no additional action is taken. However, they are effective as a first phase of any potential alternative. Scoping comments also indicated that some core actions, such as watershed management, need to be expanded to ensure that all benefits are realized.

Implementation Methods

Approximately 50 separate actions make up the set of core actions (detailed in Workshop 6 packet). While implementation methods vary, incentives and willing partnerships are a foundation of many of the actions. The goal is to make progress toward a lasting solution in the Bay-Delta without waiting many years for completion of the Program. The core actions are the first phase of each potential alternative.

The following distinguishing criteria further define core actions:

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- A core action would measurably contribute to achieving one or more Program objectives.
- A core action is broadly supported by stakeholders whether or not the CALFED Bay-Delta Program exists or succeeds.
- A core action is compatible with and beneficial to all possible outcomes of the CALFED Bay-Delta Program.
- A core action would be beneficial and cost-effective in contributing to Program objectives, either over the long term or only during the interim until the long-term Bay-Delta solution is selected and implemented.
- A core action must be implementable at a reasonable cost, individually and collectively with other core actions, that is acceptable to all stakeholders.
- A core action could consist of using the CALFED Bay-Delta Program as an institutional framework for promoting, planning, coordinating, consolidating, and/or funding an action that otherwise generally falls under the purview of another agency (but has not been implemented because of lack of specific approval or funding).
- A core action could be implemented independently from the CALFED Bay-Delta Program.
- A core action would emphasize immediate implementation through voluntary and cooperative partnerships with landowners or other participants.

The following criteria distinguish core actions from other types of actions:

- A core action cannot preclude or conflict with implementing other actions.
- A core action cannot increase the level of conflict between Bay-Delta beneficial uses or among stakeholders.
- A core action does not yet have approval and funding for implementation by another agency or entity (thus, actions approved and fully funded by the Central Valley Project Improvement Act or as Category III projects would not qualify as core actions; actions that could be funded by future measures could qualify as core actions).
- A core action cannot be solely viable as part of a major Program alternative and cannot be so expensive that it is acceptable only in conjunction with other major actions (thus, construction of major structural facilities would not qualify as a core action).
- A core action cannot redistribute costs and benefits of Bay-Delta beneficial uses.

Relationship to Other Components

Because the core actions are essentially the first phase of any alternative, they work well with all the other variable and common components.

Potential Benefits and Adverse Effects

Potential benefits of the core actions include:

- Core actions provide for early implementation and resultant progress toward the Program objectives before completion of studies, design, and implementation of the remaining actions that will make up the Program many years from now.

- Core actions are effective as a first phase of any potential alternative.

Potential adverse effects of the core actions include:

- Requires a significant dollar commitment and may provide only marginal benefits.

Water Use Efficiency Program Measures

Description

The Bay-Delta system provides the water supply for a wide range of instream, riparian, and other beneficial uses. As water use and competition among uses with respect to timing of water availability have increased during the past several decades, conflicts have increased among uses of Delta water which in turn have magnified the impact from natural fluctuations in the hydrologic cycle. Making more efficient use of water is an important way to reduce the mismatch between the available water supply and timing and the combined beneficial needs for that water.

Water use efficiency measures include various programs that seek to reduce the demand for water and increase the reuse of water in the system. These measures include agricultural and urban conservation, water recycling or reclamation, and temporary and long-term land conversion to other uses.

Upstream of the Delta, water use efficiency methods can make water available for other uses and help shift the timing of diversions for reduced impact on fisheries. South of the Delta, water use efficiency methods can 1) make water available for other uses, 2) reduce the shortages that typically occur for many water users (environmental and other beneficial users) during extended droughts, 3) reduce diversions at times to provide some increase in Delta outflow, 4) increase time before new facilities are needed, and 5) potentially allow for smaller sizing of new water facilities.

A number of comments received during scoping have lead us to conclude that water use efficiency measures might be treated as a program that is generally uniform between the alternatives. Some of these comments are:

- Hardening of Demand (i.e., increases need for reliability);
- Each alternative should have a stronger theme for water use efficiency;
- Should recognize the difference between long-term conservation and shortage measures;
- Water use efficiency needs to be preserved as a local implementation item;
- Not room for additional reduction in many basins at full efficiency.

While the water use efficiency component will be implemented at one comprehensive level for all alternatives, some minor adjustments may be needed depending on geographic or physical characteristics of a given alternative. For instance, new storage can modify the operations and extend the effectiveness of water use efficiency.

The component will consist of actions or projects which are initiated in the first stage of the alternative with continued implementation over time. As implementation progresses, monitoring of effectiveness of the early stages will help refine later stages of implementation. The specific level of implementation will be defined during future phases of the Program by a combination of analyses and policy decisions.

Implementation Methods

The water use efficiency methods include programs that provide incentives for:

Best Management Practices (BMPs) - Incentives to achieve improved use of BMPs by more municipal/industrial water suppliers and users and to expand the BMPs to include additional practices and higher implementation rates, resulting in less water use particularly in areas where the excess water is not returned for beneficial use.

Efficient Water Management Practices (EWMPs) - Incentives to achieve broader application of EWMPs by more agricultural water suppliers and users and to expand the EWMPs to include additional practices and higher implementation rates, resulting in less water use particularly in areas where the excess water is not returned for beneficial use (e.g., salt sinks).

Temporary and Long-Term Land Conversion - Incentives to encourage temporary land conversion to other uses or fallowing during drought periods to reduce dry year demand and long-term land conversion to make water available for other uses.

Water Recycling or Reclamation - Implement urban wastewater recycling options, such as recharging groundwater, using for agricultural irrigation, recycling and treating for potable or

non-potable urban use, use of grey water, and storage for use in meeting Delta flow standards. Treat and recycle agricultural drainage for irrigation purposes, while maintaining appropriate salt leaching requirements. The use of recycled water will increase the overall availability of water and may reduce the amount of Delta exports at times.

NOTE: A BDAC Water Use Efficiency Work Group is assisting CALFED Program staff in identifying policy issues with respect to water use efficiency implementation. The Work Group will also help to identify techniques which encourage implementation of water use efficiency programs and integrated resource planning at the local level.

Relationship to Other Components

New Surface Storage, Conjunctive Use/Groundwater Banking - New storage helps reduce impacts of water use efficiency methods by shifting the timing of flows (short- and long-term). The effectiveness of water use efficiency methods can be enhanced by storage of the saved water for later use.

Through Delta, Isolated, or Dual Conveyance - Improved conveyance to the South Delta export pumps will help move water when it is needed. The opportunity for transfers will be increased, which will provide market incentives for implementation of water use efficiency actions.

Water Quality Improvements - Conversion of certain drainage-affected agricultural lands to other uses may reduce the pollutant load entering the Delta.

Potential Benefits and Adverse Effects

Potential benefits of the water use efficiency program include:

- Reduces demand for Delta exports and related entrainment effects on fisheries;
- Can help in timing of diversions for reduced entrainment effects on fisheries;
- Could make water available for transfers;
- May delay need for new water facilities;
- May improve overall Delta and tributary water quality.

Potential adverse effects of the water use efficiency program include:

- Increased water use efficiency can result in potential water user hardships, such as lost production, third party impacts, and increased costs.
- Hardened Demand.
- Average year conservation may produce few critical year benefits.

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- Land fallowing can have severe economic impacts on "third parties" including suppliers, workers and local governments.

Water Quality Improvements

Description

The Delta is a source of drinking water for millions of Californians and is critical to the state's agricultural sector. Appropriate water quality and sufficient nutrients are required to maintain the high quality habitat needed in the Bay-Delta system to support a diversity of fish and wildlife populations. Export water users require low salinity levels, and urban suppliers need low nutrient levels to maintain reasonable water treatment costs. A conflict over water quality in the system results from the fact that land uses often do not contribute to good water quality, and ecosystem water quality needs are usually, but not always, compatible with urban and agricultural water quality needs.

Pollutants enter the Delta through a variety of sources, including sewage treatment plants, industrial facilities, forests, farms and farm fields, mines, residential landscaping, urban streets, and natural sources, such as tidally-induced salinity intrusion into the system. Contaminants enter the system from upstream sources and from sources within the Delta. Natural seawater intrusion, exacerbated by diversion patterns, adds chlorides and bromides to exported supplies, and agricultural drainage adds chlorides and organic carbon. These constituents combine to produce potentially hazardous water treatment byproducts when subjected to municipal water treatment processes. Other constituents contributed by wastewater treatment plant discharges to system tributaries further complicate the pursuit of good raw drinking water quality for urban needs. The practice of drawing higher natural salinities and agricultural drainage to diversion points produces a self perpetuating cycle of increasing volumes of salt in exported water supplies.

The water quality improvement focus in the common plan will be on pollutant source control. Reducing the total pollutant load entering the Delta will provide benefits for all water users. These include improved drinking water quality, reduced salt load for agricultural diversions, and improved water quality for the ecosystem, including reduced toxicity. Additional benefits can also be obtained by timing release of remaining pollutant discharges.

A number of comments received during scoping have lead us to conclude that water quality improvements might be treated as a program that is generally uniform between the alternatives. Some of these comments are:

- The alternatives must address the issue of how each will obtain the best source of water for urban needs;

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- Alternatives should not suggest that the dilution of pollutant elements will satisfy the goal of improving water quality;
- Address salt and chemical recirculation of each alternative;
- Reduction of pollutants at the source should be a main focus of the Program;
- The Program needs to address the San Joaquin drainage issue;
- Any alternative which degrades Delta water quality must not be considered;
- Degradation of water quality when transported through the Delta affects the ability of urban agencies to recycle water;
- Disinfection by-products resulting from bromides in Delta water is a concern;
- Improve and augment water quality actions in all alternatives.

While the water quality improvement component will be implemented at one comprehensive level for all alternatives, some minor adjustments may be needed depending on geographic or physical characteristics of a given alternative. For instance, the use of isolated conveyance may require more focus on in-Delta water quality than an alternative with through-Delta conveyance.

The components will consist of actions or projects implemented in stages over time. As implementation progresses, information on effectiveness of the early stages will help refine later stages of implementation. The specific level of funding for implementation will be defined during future phases of the Program by a combination of analyses and policy decisions. The analyses will consider the costs of achieving various pollutant load reductions to the Delta and the costs of treating for drinking water.

Implementation Methods

Pollutant source control consists of actions to reduce discharges of water quality constituents of concern to aquatic habitats and water users in the Bay-Delta system and its tributaries. Implementation includes encouraging voluntary compliance for Best Management Practices and other measures that control sources of salinity, selenium, pesticide residues, and heavy metals as well as increased levels of implementation for water quality improvement including:

- coordinate developing efficient water quality management practices;
- increase enforcement of source control regulations for agricultural drainage to reduce leachate concentrations and volumes, restrict spray programs adjacent to waterways, reduce runoff volumes, and reduce concentrations of pollutants in runoff;
- construct wetlands to treat upstream wastewater effluent and Delta agricultural drainage;
- manage drainage timing;
- improve management of urban stormwater runoff including increased Best Management Practices and by retaining and timing discharges;
- coordinate land conversion to reduce costly water quality related drainage problems in the San Joaquin Valley;

- watershed protection program development;
- filtration system upgrades and phased conversion of municipal treatment facilities from processes resulting in high disinfection byproduct precursors (DBP) discharges to processes that do not produce DBPs;
- mine drainage remediation;
- actions to reduce effects of salinity in the San Joaquin River to maintain water levels and circulation in the south Delta and to reduce recycled salt load to the San Joaquin Valley;
- provide water for dilution of pollutant discharges remaining after above source control methods.

Relationship to Other Components

New Surface Storage, Conjunctive Use/Groundwater Banking - Storage can help timing for release of pollutants remaining after source control efforts.

Through Delta, Isolated, or Dual Conveyance - Improved conveyance to south Delta export pumps will improve water quality for those diversions but may decrease quality for in-Delta diversions.

Water Use Efficiency - Water use efficiency measures can improve water quality entering the Delta by reducing some agricultural drain water containing pollutants.

Potential Benefits and Adverse Effects

Potential benefits of the water quality program include:

- Improves Delta water quality by reducing the volume of urban and agricultural runoff/drainage and concentration of pollutants entering the Delta;
- Improves water quality for the ecosystem by reducing toxics as a limiting factor;
- Improves drinking water quality and public health benefits.

Potential adverse effects of the water quality improvement program include:

- Retention of agricultural drainage and changing the timing of releases to the river and Delta does not change the total mass of salts recycled through the San Joaquin Valley irrigation system;
- Treatment systems for agricultural drainage may be prohibitively expensive. Wetland treatment systems may expose wildlife to toxic effects;
- Source control actions for agricultural drainage may be prohibitively expensive for some agricultural interests;

- Management of urban stormwater runoff may be prohibitively expensive and may require unrealistic legislative initiatives to implement.

System Integrity

Description

The Bay-Delta system faces an unacceptably high risk of inundation of Delta islands due to potential levee failure, which can result in loss of land use, infrastructure and associated economies, damage to ecosystem habitats, reduced water supply reliability, and reduced water quality in the Delta. Agricultural productivity and significant habitat for terrestrial species would be severely damaged by inundation of one or more Delta islands. In addition, increased salinity intrusion would likely cause significant impacts to aquatic freshwater habitat and water supply operations.

Improvements to Delta levees and channels are included in this common component to reduce the risk of failure due to floods, earthquake, and general deterioration of the facilities. These improvements to system integrity will be accomplished through development and implementation of the Delta Long-Term Levee Protection Plan. The plan will include a maintenance/stabilization element and a Special Projects element that collectively will address levee maintenance, stabilization improvements, subsidence reduction, an emergency levee management plan, beneficial reuse of dredged material, and establishment of habitat corridors as mitigation for impacts from maintenance and stabilization.

The Delta Long-Term Levee Protection Plan will provide a uniform approach for improving system reliability. Uniform funding and guidance for levee maintenance and/or improvements to a set standard would be provided on a cost-shared basis for Delta islands. Funding for flood control and habitat improvements would be on a prioritization system to ensure long-term protection of Delta system functions providing the highest public benefit.

A number of comments received during scoping have lead us to conclude that the system integrity might be treated as a program that is generally uniform between the alternatives. Some of these comments are:

- Most parties support an enhanced levee stabilization program;
- A greater level of levee stabilization needs to be implemented (PL99) in all alternatives;
- Flood control measures in the North Delta need to be included in all alternatives;
- A consistent level of funding for levee maintenance needs to be provided;
- Needs to be a single regional authority to coordinate Delta system integrity actions.

While the system integrity component will be implemented at one comprehensive level, some minor adjustments may be needed depending on geographic or physical characteristics of a given alternative. For instance, a through-Delta alternative may use islands and channels for conveyance and thereby dictate how levees and channels in certain areas need to be improved.

The components will consist of actions or projects implemented in stages over time, perhaps 20 to 30 years, to ensure long-term protection. As implementation progresses, information on effectiveness of the early stages will help refine later stages of implementation. The specific level of funding for implementation will be defined during future phases of the Program by a combination of analyses and policy decisions. The analyses will include a risked-based benefit/cost analysis.

Implementation Methods

The Delta Long-Term Levee Protection Plan will consist of several elements. These elements will address levee maintenance and improvements to achieve a long-term goal of reducing the vulnerability of Delta functions throughout the Delta and identify stable funding sources. A strategic plan for Delta islands will be developed. The plan will prioritize work on highest priority sites anywhere within the Delta. High-priority sites would be identified through a ranking scheme that is expected to include criteria such as the protection of public infrastructure facilities (e.g., highways, pipelines, railroads), private infrastructure (e.g., homes, marinas), navigation (e.g., project/direct agreement levee systems), water quality at Delta export locations (e.g., west Delta islands), flood protection, cultural resources, recreation, and fish and wildlife. The elements include:

Levee Maintenance Plan - Establish a stable source of funding for levee maintenance and establish a uniform long-term Delta standard, including maintenance guidelines, which can incorporate habitat friendly levee maintenance procedures.

Stabilization of the Highest Priority Western Delta Island Levees - Significant improvement in reliability of Delta water quality and the water conveyance system can be accomplished while incorporating aquatic habitat restoration and enhancement features, which can produce immediate benefits in stabilizing fishery populations, complementing the increased certainty for water supply produced by the protections to through Delta water conveyance tied to the levee stabilization.

High Priority Buffer Zones - Provide incentives for setting aside high priority buffer zones adjacent to levees of Delta islands with deep peat soils to control subsidence, maintain levee stability, and provide areas for habitat restoration. This land conversion may reduce demands on Delta water and reduce discharges of organics and other constituents into Delta channels. Additional more aggressive long-term subsidence reversal programs could be included for some islands.

Restoration of Highest Priority Habitat - This action can be integrated with efforts to establish buffer zones for subsidence control or implementation of mitigation banking opportunities for levee maintenance/improvement actions. Restoration efforts would be monitored for results and appropriate adjustments made in future restoration efforts.

Emergency Levee Management Plan - Identify a stable source of funding for an emergency levee management plan to address Delta levee failures through enhanced coordination of existing agencies and ensuring adequate availability of materials and equipment.

Relationship to Other Components

Through Delta, Isolated, or Dual Conveyance - Levee and channel improvements for conveying water to the South Delta export pumps should made in conjunction with flood control and aquatic habitat improvements.

Potential Benefits and Adverse Effects

Potential benefits of the Delta Long-Term Levee Protection Plan include:

- Subsidence reduction helps long-term Delta system integrity;
- Ensures suitable funding, equipment and materials availability, and coordination to rapidly respond to levee failures;
- Provides funding for continued maintenance of levees to protect Delta functions;
- Increased reliability for water supply needs from the Delta;
- Increased reliability for in-Delta land use and habitat;
- Increased reliability for in-Delta aquatic and wildlife habitat.

Potential adverse effects of the Delta Long-Term Levee Protection Plan include:

- Providing increased levee stability and higher levels of flood protection in a staged fashion can expose adjacent islands to higher levels of flood risk until their priority is reached in the staged program;
- Attempting to reach a uniform level of flood protection may be prohibitively expensive;
- Creating aquatic habitat as part of levee stabilization work may impact terrestrial habitats;
- Creating subsidence buffer zones may remove agricultural lands from production and impact terrestrial habitats;
- Improving flood protection in the North Delta may impact both aquatic and terrestrial habitats;
- Without an adequate subsidence control plan, levee stabilization may not be successful over the long term in the peat soil areas of the Delta.

Ecosystem Restoration

Description

CALFED is working to achieve a healthy Bay-Delta ecosystem that provides for the needs of plants, animals, and people using the system. This healthy ecosystem will include a range of sustainable habitat types, providing environmental, recreational, and aesthetic benefits. It will support an abundance of resident and andromous fish, including viable recreational and commercial fisheries. A healthy ecosystem will also support sustainable production and survival of plant and wildlife species, including resident species as well as migrants such as the waterfowl that use the Pacific Flyway each winter. These qualities are benefits or ecosystem services that a healthy Bay-Delta ecosystem will provide.

These sustainable fish, wildlife, and plant populations depend on an ecosystem that provides all the natural processes and features, called ecosystem functions, that they need. The Bay-Delta system will never be returned to the conditions that existed prior to human disturbance, but Bay-Delta ecosystem functions will be restored. A healthy functioning ecosystem will include all the habitats necessary for survival of species that use the system, including freshwater and brackish tidal marsh, shallow water, riparian woodlands, and shaded riverine areas. These habitats will be large enough in area to support sustainable populations of Bay-Delta species, and will be interconnected to allow movement and prevent isolation of plant or animal populations. To the extent possible, natural processes of the system will be restored, including proper water flow to ensure appropriate salinity levels, meander belts that create necessary habitat and generate sediments that are important to the system, and nutrients that support the food web of the system.

A number of comments received during scoping have lead us to conclude that habitat restoration might be treated as a program that is generally uniform between the alternatives. Some of these comments are:

- The Program needs to expand watershed management techniques and actions as part of overall effort;
- Clarify and elaborate restoration definition, goals, objectives, etc. Need a more fully developed plan;
- How is Program treating overall increases in Delta outflow? Will this be explicit in the restoration activities?;
- Need to discuss outflow enhancements and instream flow requirements;
- The Program needs to develop a broad vision and a high level ecosystem restoration plan and make that common to all alternatives;
- Need to develop guarantees that the ecosystem actions will be effective.

While the ecosystem restoration component will be implemented at one comprehensive level, some minor adjustments may be needed depending on geographic or physical characteristics of a given alternative. For instance, habitat restoration activities could be located differently, depending on use of through-Delta or isolated conveyance.

The components will consist of actions or projects implemented in stages over time. As implementation progresses, information on effectiveness of the early stages will help refine later stages of implementation. The specific level implementation will be defined during future phases of the Program by a combination of analyses and policy decisions.

Implementation Methods

The Program's strategy for habitat restoration is to reverse the decline in ecosystem health by reducing or eliminating factors which degrade habitat, impair ecological functions, or reduce the population size or health of species. These factors may cause direct mortality of plants and animals in the system, but more often they result in indirect mortality by degrading habitat conditions or functions. For this reason, the Program objectives emphasize the improvement of habitats and ecological functions.

When there is a single factor limiting (or stressor) an ecological function or the population size or health of a species, remedial actions to restore functions or populations are clear. Often, however, there are many factors that reduce ecological functions or cause mortality of species at different stages in the life cycle. In the Bay-Delta system, some of these include inadequate physical habitat that fails to provide areas for reproduction, foraging, or escaping from predators; inadequate water quality including temperature and toxic contaminants; fragmented habitat that impedes migration; inadequate or altered water flow regimes; direct and indirect mortality caused by water diversions from the system; presence of undesirable introduced species that compete with or prey upon other species; and recreational and commercial harvest. In cases where there are multiple factors affecting species, the strategy of the Program is to take a broad ecosystem approach, thus making incremental improvements in all the significant identified factors that affect important species and their habitats. This effort must start by addressing factors most likely to be limiting, particularly for species of special concern. Subsequent efforts will work to protect or restore broader ecosystem functions. Actions may be guided by pre-disturbance conditions, but must recognize competing uses of the system, and irreversible changes that have occurred.

Several criteria will help to focus efforts aimed at maintaining and restoring ecosystem functions and achieving ecosystem quality objectives:

- **Address Limiting Factors** - Restoration of ecosystem functions must begin with the greatest needs or deficiencies in the system.

- **Use Natural Processes** - Selection of actions will favor those that take advantage of natural processes to achieve desired results. This will reduce the amount of effort to carry out and maintain our actions, and increase the likelihood of long-term sustainability of the Bay-Delta system.

- **Increased Resilience** - Actions will be selected so that some of the system's natural resilience to disturbance is restored. Restoration of particular habitat types will be undertaken at appropriate sites distributed throughout the system, and genetic diversity will be protected so that species maintain the ability to respond to gradual changes in conditions. Genetic diversity is most at risk in species or races that are endangered, threatened, or of special concern.

- **Achieve Multiple Benefits** - Efforts will be made to increase benefits by selecting or designing actions that improve habitat conditions or ecological functions for multiple species. Actions will also be favored if they improve other resources areas including water quality, system integrity, and water supply reliability as well as improving ecosystem quality.

- **Measure Results** - Program results will be measured on two different levels. First, actions will be structured so that the effectiveness of each one is measurable. At a broader scale, the Program will include monitoring to assess the overall success of the many actions working together. This will allow adaptive management of the restoration: adjustment of our actions to make them more effective, and changes in emphasis as the condition of the ecosystem improves.

- **Make up for Unavoidable Loses** - Finally, where competing uses of Bay-Delta resources make it impossible to avoid specific impacts on species, habitats, or ecological functions, efforts will be made to compensate by reducing other causes of mortality or improving habitats and functions elsewhere in the system.

A variety of actions are contemplated as building blocks for the Program:

Protect and Enhance Existing Bay-Delta Habitat - Protecting and enhancing existing valuable habitat before it is lost to further degradation is critical. The habitats include shallow areas adjacent to levees, channel islands, riparian habitats, wetlands, and upland habitats.

Restore Habitat - Substantial restoration of habitats in the Bay-Delta system is required to improve the ecosystem function. Many of these can be incorporated into habitat corridors. These include:

- improving Bay-Delta shallow water (tidal) habitat, including converting existing leveed lands to tidal action and incorporating shallow water habitat in the reconstruction of levees;

- restoring riparian habitat by revegetation and expansion at in-Delta tidal areas, within-island sites, and in the river system, including the Sacramento River corridor and its tributaries, the San Joaquin River corridor and its three major tributaries;
- converting diked wetlands to tidal wetlands habitat in the Suisun Bay;
- improving riverine habitat on the Sacramento River and along Delta channels by reconstructing river banks and protecting channel islands;
- restoring floodway functions and expanding meander belts, and
- expanding wetlands.

Acquire Environmental Water - Water can be acquired from willing sellers for improving instream flows, increasing Delta outflow, and other environmental needs.

Habitat Management - A variety of actions can be used to improve management of Bay-Delta system habitats, including changes in levee maintenance procedures, changes in agricultural practices, improved coordination between agencies and programs, and improved permitting for habitat restoration.

Control of Introduced Species - Improved control of introduced species helps protect and enhance the natural ecosystem values of the Delta by reducing competition.

Fish Screens - Improvements in fish screening throughout the Bay-Delta system can have a significant reduction in loss of fish.

Fish Protection and Management - Improving protection and management of fish in the Bay-Delta system are important to sustaining healthy populations. These involve management of spawning gravels, modification of barriers that restrict fish passage and migration, use of real-time monitoring and adaptive management, management of hatchery fish, and improving data management for regulation of fish harvest.

NOTE: A BDAC Ecosystem Restoration Work Group is assisting CALFED Program staff in identifying key policy issues with respect to restoration of ecosystem health.

Relationship to Other Components

New Surface Storage, Conjunctive Use/Groundwater Banking - Storage can improve instream flows, Delta outflows, and modification of timing of diversions.

Through Delta, Isolated, or Dual Conveyance - Improved conveyance to the south Delta export pumps can improve timing of diversions to reduce impacts on fish.

Water Quality Improvements - Water quality improvements through source controls and timing of remaining pollutant releases improves water quality and reduces toxicity for the ecosystem.

System Integrity - Improvements of levees and channels for improved system integrity can also incorporate new habitat features.

Water Use Efficiency - Reduced diversions associated with water use efficiency measures helps reduce diversion effects on fisheries.

Potential Benefits and Adverse Effects

Potential benefits of the habitat restoration program include:

- Reverse the decline in ecosystem health by reducing or eliminating factors which degrade habitat, impair ecological functions, or reduce the population size or health of species;
- Produces a healthy Bay-Delta ecosystem that provides for the needs of plants, animals, and people using the system;
- Supports sustainable production and survival of plant and wildlife species, including resident species as well as migrants such as the waterfowl that use the Pacific Flyway each winter.

Potential adverse effects of the habitat restoration program include:

- Restoration of Suisun Bay tidal wetland habitat may impact waterfowl habitats;
- Setback levees along the Sacramento and San Joaquin Rivers may remove agricultural land from production and may increase flood risk to downstream areas;
- Restoration of riparian habitats adjacent to levees may increase the difficulty of maintaining safe and stable levees and may increase risk of levee catastrophic failure;
- Reestablishment of river meander zones may increase sediment loads and impact downstream navigation channels; sediment loads may also increase maintenance costs for flood bypass systems;
- The enhancement of fishery populations may increase concentrations of protected species around water system intakes and produce short-term operational impacts;
- Floodway conversions to habitat may increase maintenance costs or impair floodway capacities; there may also be impacts to agricultural acreage;
- Depending on how the program is implemented, actions to address salmon migration at the head of Old River may impact water stages and quality as well as flood stages in the south Delta channels.

VARIABLE COMPONENTS

Many of the comments received during scoping and at Workshop 6 focused on the need for increased emphasis on storage and Delta conveyance for better water supply and flow management. Some of these comments are:

- The issue of a common pool vs. an isolated facility should be addressed and then integrated into each of the alternatives;
- The alternatives do not appear to increase overall supply of water. Current wording could be interpreted that exports could be cut in half and still meet CALFED Bay-Delta Program goals;
- Dual and through Delta conveyance protect Delta water quality. How would an isolated facility be formulated to protect quality in the Delta;
- Regional flood control issues need to be described in all conveyance options;
- Discuss isolation of drinking water for dual conveyance;
- Discuss opportunity for water transfers;
- Discuss the need to free up Delta constraints before storage can be effective;
- Discuss expanding existing storage as a high priority (raise dams);
- Provide more storage options;
- Prioritize conjunctive use first, then groundwater banking, then surface storage.

Due to the importance and complexity of these issues, we have created separate components for **storage** and **conveyance** that require additional analyses to refine sizes and operations. Unlike the common components discussed above, both storage and conveyance will be variable components that differ with each alternative. Conveyance will be a variable component with four potential configurations for moving water through the Delta. Storage will be a variable component with surface and conjunctive use/groundwater banking elements.

General descriptions of each of these variable components follows. Work will continue in analyzing and refining how they may work with the common components to meet Program objectives.

Storage

Description

The Bay-Delta system provides the water supply for a wide range of environmental, agricultural, and urban beneficial uses. As water use and competition among uses with respect to timing of water availability has increased, conflicts have increased among uses of Delta water. Adding

more storage is a possible action in each alternative. Surface storage of water and conjunctive use/groundwater banking can be used to greatly increase the opportunities to improve the timing and availability of water for all water users. The benefits and impacts of surface and groundwater storage vary depending on the location, size, operational policies, and linkage to other components. Depending on the configuration of the alternative the benefits and impacts may be very different between storage located upstream of the Delta, in-Delta, and south of the Delta.

Surface storage can be either new or a modification of existing storage, each with different benefits and potential adverse impacts. Opportunities for increased conjunctive use in the Sacramento basin and groundwater banking in the San Joaquin basin need to be quantified to determine the benefits and potential adverse impacts. To determine the optimum combination of surface and groundwater storage for any alternative, a full range of size, locations, and operational polices must be examined in Phase II. Shared use of storage for environmental, water supply, and water quality will be optimized to determine the most cost effective benefit from the storage and other components of the alternative.

Implementation Strategies

Surface storage can be constructed upstream of the Delta, off stream in the Delta, or off stream south of the Delta. Conjunctive use/groundwater banking operations and impacts vary with configuration and location.

Upstream Surface Storage - Runoff from precipitation north of the Delta usually occurs in large volumes over short periods of time in the winter and spring. New upstream off stream storage would capture a small portion of flows in excess of instream flow requirements and water supply needs. Water would only be diverted to the new storage following the peak flood flow, maintaining the beneficial geomorphologic effects of the highest flows. Water would be released when needed to supplement instream flows and for water supply. For example, water in north of Delta storage could be released directly to current north of Delta water users, reducing existing diversions from the Sacramento River. Water released for environmental purposes could include pulse flows to help transport fish through the Delta. Water could also be released to provide sustained flows for riverine and shallow water habitats and improve water quality in the Delta, particularly in dry years. Upstream conveyance approach may need to include conveyance modifications.

In-Delta Surface Storage - In-Delta storage could be developed by converting one or more Delta islands into reservoirs. Existing levees would be reconstructed, and screened facilities for diverting water into the island would be provided. In-Delta storage would be filled during wet periods when probable harm to critical fishery resources would be lowest. Water would be released directly into the Delta for environmental, water supply, and water quality needs or connected directly to the export facilities to provide flexibility in diversion timing.

South of Delta Surface Storage - South of Delta storage would be filled by diversions which supply the Delta Mendota Canal or the California Aqueduct. Examples of existing south of Delta storage are San Luis Reservoir, and Castaic Lake. Storage would be filled during wet periods of least potential harm to Delta fishery resources. With water in storage south of the Delta, export pumping could be curtailed at times of heightened environmental sensitivity.

Conjunctive Use - Conjunctive use is the management and operation of a groundwater basin in a manner similar to on stream reservoir operations to provide limited short-term flexibility in meeting water supply demands. Groundwater is removed and subsequently recharged over a period of years or within a particular year. Groundwater levels would tend not to drop drastically as a result of constant recharge from rivers and streams as well as direct recharge. In addition, groundwater levels would not tend to rise significantly above historic levels because of loss to river accretion. During drier periods, groundwater would be extracted for use in place of or to supplement surface water supplies within the region. In wetter periods, river and stream seepage as well as direct recharge will return the groundwater levels to previous equilibrium conditions.

Groundwater Banking - Groundwater Banking is the storage of water in existing depleted groundwater basins and the subsequent extraction and use of the stored water to meet water supply demands. Typically, large quantities of water can be stored in such basins without loss of storage that could result from river or stream accretion. During wet periods, surface water would be delivered to these basins and stored for a period of months or years. During drier periods, the storage would be extracted and used in place of or subsequent to surface water supplies.

Phase II Analysis

During Phase II of the Program, a full range of storage options, including conjunctive use, groundwater banking and surface storage will be examined for each of the variable conveyance components.

The range will be broad enough to ensure that all technically feasible and cost-effective combinations are analyzed.

Relationship to Other Components

Conveyance improvements and conveyance facilities could complement new storage. Conjunctive use and groundwater banking programs could be optimized by the addition of surface storage.

Conveyance - Conveyance would increase the ability to convey water from north of the Delta to south of the Delta at environmentally acceptable times. Upstream surface storage would accommodate shifts in export diversion timing by storing water until it can be diverted. Water would then be released to the conveyance facilities. Water could also be stored and released to

manage Delta outflows. South of Delta storage would permit the increased conveyance capacity to be used during acceptable periods. During other times, water users would draw on the storage and export diversions would be reduced.

Conjunctive Use/Groundwater Banking - Groundwater recharge and extraction facilities could be optimized if new surface storage is used to regulate flows into and out of the groundwater basin.

Water Use Efficiency - As increased efficiencies reduce demands on the Delta, storage can improve flexibility in the management of the water conserved for the existing supplies and reliability of the future supplies.

Water Quality Improvements - The timing of releases from storage can greatly improve water quality at critical times.

Ecosystem Restoration - All types of storage facilities increase the flexibility to help manage the downstream flow for environmental purposes.

Potential Benefits and Adverse Impacts

Potential benefits of surface storage and conjunctive use/groundwater banking include:

- Flexibility to coordinate supply opportunities;
- Dry period supply opportunities;
- Shift water use patterns for habitat and fisheries;
- Management of downstream water temperatures;
- Increase annual supply opportunities;
- Enhance water transfer opportunities;
- Flexibility to reduce entrainment;
- Improve timing of Delta outflow;
- Increased flood control;
- Increased recreational benefits;
- Increased power generation.

Potential adverse effects of surface storage and conjunctive use/groundwater banking include:

- Reduced total Delta outflow;
- Increased total diversion rate in particular flood flow periods;
- Increased Bay stratification impacts;
- Site specific terrestrial and wildlife impacts;
- Potential loss of culture resources;
- Water quality impacts;
- Adverse effects of landuse change;

- Decreased gravel recruitment;
- Increased average and above year surface deliveries;
- Terrestrial impacts in dry and critically dry years;
- Impacts on adjacent groundwater users;
- Increased subsidence (In-Delta storage).

Conveyance

Description

Operation of Bay-Delta system diversions in general and in-Delta diversions in particular adversely impact fish species that reside in or pass through the Delta. Fish and fish eggs are entrained at diversions. Also, south Delta diversions induce flows that draw fish into areas where they are subject to delay and predation. These diversions create a conflict between water supply and fishery beneficial uses. In the 10 alternatives presented in Workshop 6, several methods are used to convey water across the Delta. They consist of using the existing system, making through Delta modifications, isolated conveyance, and a combination of through Delta and Isolated (a dual system). Each method, or conveyance component, has unique benefits and could have potential adverse impacts on the Delta depending on the size and operational policies. Linked with the other components of an alternative, a detailed analysis of operational and water quality analysis need to be performed on a range of sizes and configurations to determine the optimum characteristics of and operational policies the facilities.

Implementation Methods

The different configurations of each component to convey water across the Delta are described below. New diversions on the Sacramento River could be located at any of a number of locations generally north of Walnut Grove.

Existing System - This approach involves continued use of the existing physical configuration of Delta channels for conveyance through the Delta from north to south. The permitted pumping capacity of the CVP and SWP pumps would be increased to their full physical capacity. The export pumps could then be operated at full capacity at times of reduced environmental sensitivity (e.g., late Fall to early Winter), and pumping could be reduced during times of heightened environmental sensitivity.

Through Delta Modifications - This approach involves physical modification of Delta channels to support increased conveyance through the Delta from north to south. Several concepts will be examined including channel dredging and setback levees, as well as a concept which utilizes very wide channels to convey water to the south Delta at a very low velocity, potentially providing

protection to Delta fisheries. Channels would be widened and/or deepened to support through Delta flows up to the combined export pumping capacity. The export pumps could then be operated at full capacity at times of reduced environmental sensitivity, and pumping could be reduced during times of heightened environmental sensitivity. The diversion for a through Delta facility could be screened or unscreened.

Isolated Conveyance - An isolated conveyance facility could convey water from a new screened diversion on the Sacramento River north of the Delta directly to the export pumps in the south Delta and possibly to Delta and Delta tributary water users. This would reduce the export pumping directly from Delta waters and its adverse effects on the south Delta. An isolated conveyance would also bring higher quality water to the export pumps, but also raises concern over water quality for other in-Delta diversions.

Dual Conveyance - The dual conveyance component includes both through Delta conveyance to the south Delta export pumps and isolated conveyance to the pumps. Sizing of each conveyance will consider the best features of each to reduce fishery impacts in the Delta, improve water supply reliability, and improve water quality. The dual conveyance component provides the flexibility of moving water independently through either the isolated or through Delta conveyances at times and through both conveyances during other times to best respond to actual conditions.

Relationship to Other Components

New Surface Storage, Conjunctive Use/Groundwater Banking - By regulating flows, surface or groundwater storage would optimize the capacity and operation of the conveyance system. South of Delta storage would permit the increased conveyance capacity to be used during acceptable periods. During other times, water users would draw on the storage and export diversions would be reduced. Releases from north of Delta storage could be used to manage the river flows at diversion(s). Delta conveyance modifications improve operational flexibility by increasing the ability to pump when environmentally acceptable. Storing the water during periods that would not impact fisheries improves the ability to shift pumping to less sensitive periods. In-Delta storage would provide similar benefits.

Water Quality Improvements Ecosystem Restoration System Integrity	The relationship to these components varies significantly depending on the conveyance approach selected. Additional information is being developed and will be presented for each conveyance option.

Water Use Efficiency - Conveyance modifications may improve the effectiveness of this component by increasing the ability to "save" conserved water or produce specific flow benefits.

Potential Benefits and Adverse Impacts

Benefits and impacts vary significantly between the different conveyance approaches. A benefit/impact list is being prepared for each approach.